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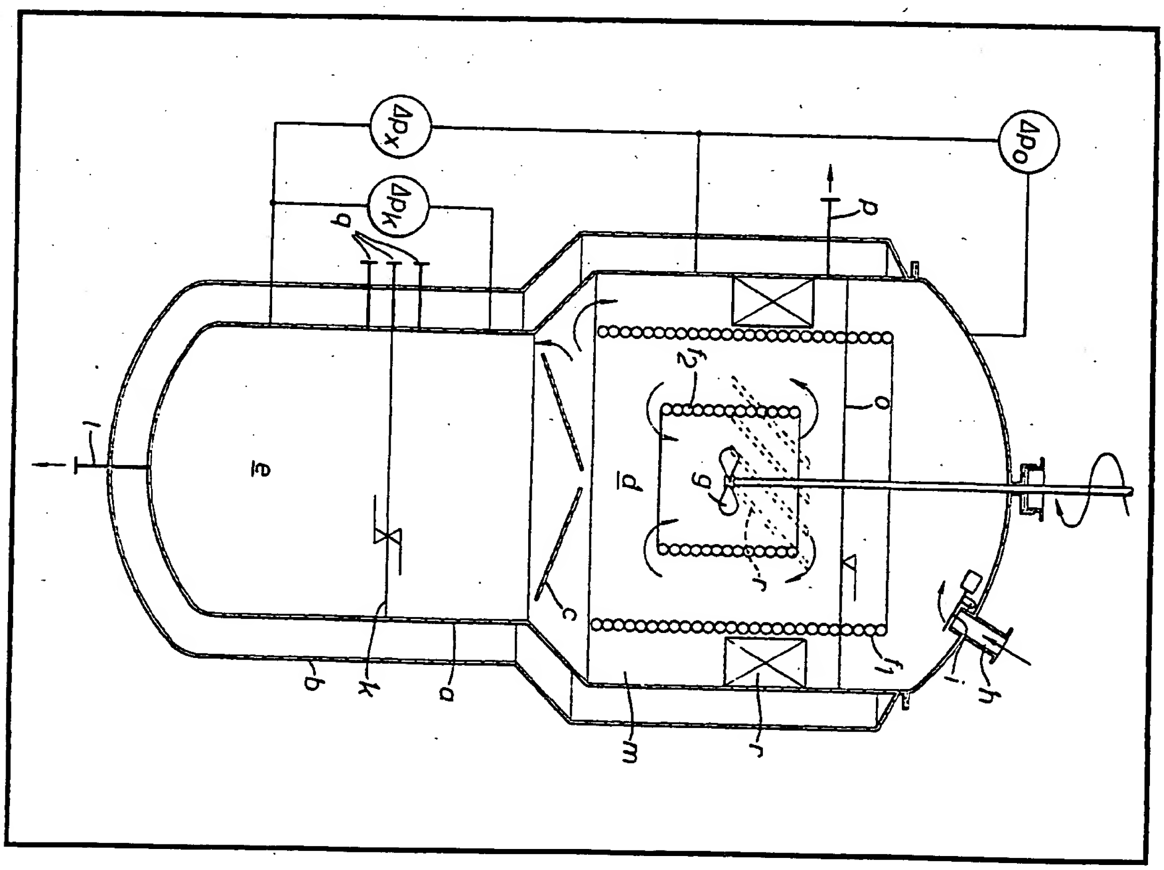
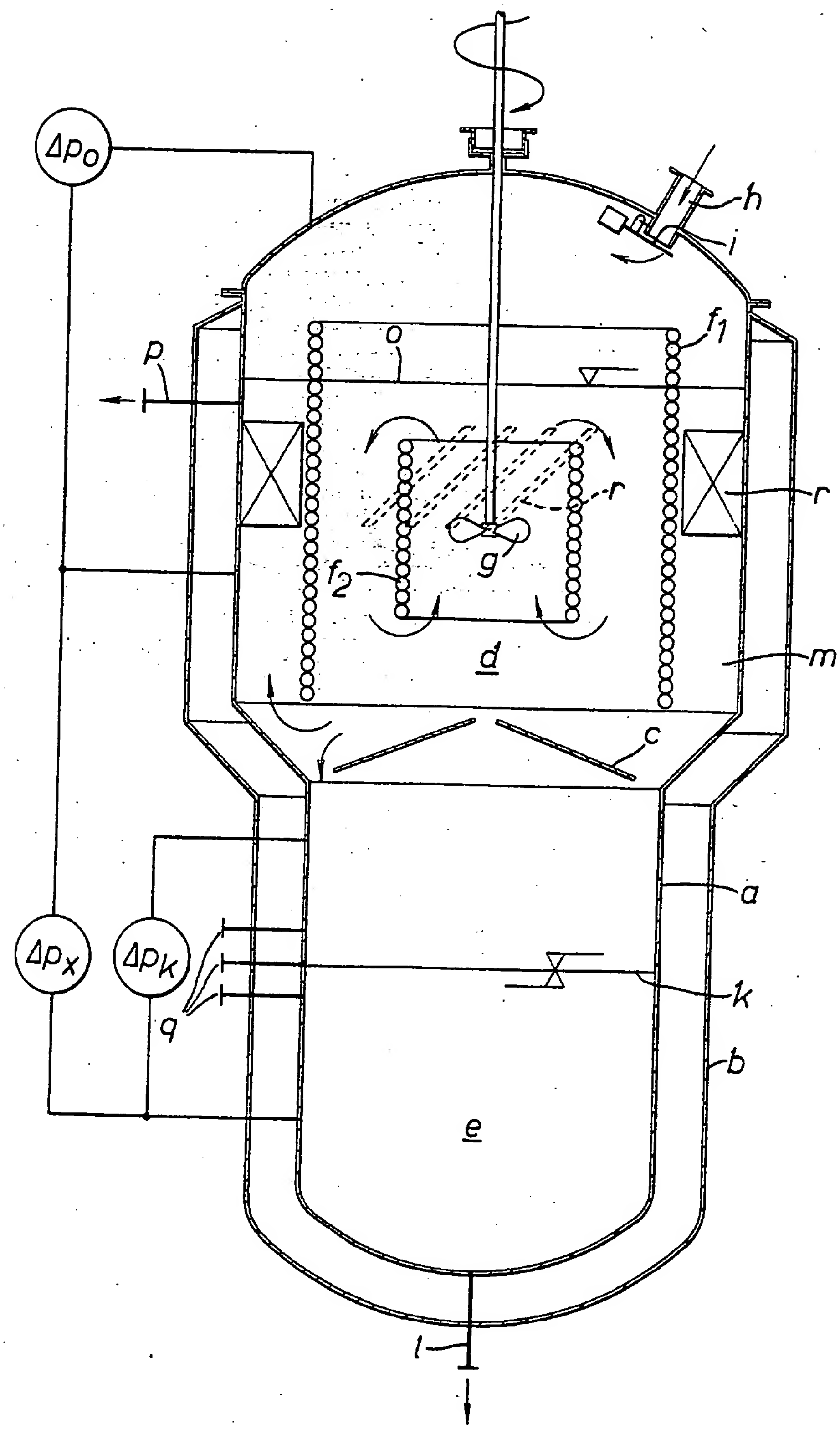
(54) Pressure vessel for separating sulphur from an aqueous sulphur suspension

(57) A heated, jacketed pressure vessel is divided into a top mixing part *d* and a bottom settling part *e* by means of an apertured partition *c*. Two coaxially spaced cylinders of heating coils f_1 and f_2, mounted one within the other, are located in the top part, the outer cylinder f_1 defining an annular chamber *m* with the wall *a* of the pressure vessel. A propellor *g* is mounted in the chamber enclosed by the inner cylinder f_2 and circulates the liquid in the vessel. A ring of inclined separator plates *r* is mounted in the annular chamber *m* in order to separate very fine sulphur droplets. Devices are provided for measuring the differential pressure between the gas and water phases and the water and sulphur phases. Regulating d vices maintain a constant water l vel *o* and phase boundary surface *k* and regulate the outflow of the separated liquids. Sulphur paste is introduced through valved nozzle *h* and the suspended sulphur melts as the paste heats up, molten sulphur being withdrawn through line 1 and water through pipe *p*.

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SPECIFICATION

Pr ssure vess l for separating sulphur from an aqueous sulphur suspension

This invention relates to a pressure vessel for use in separating sulphur from an aqueous sulphur suspension.

In one form of pressure vessel for separating sulphur from an aqueous suspension, the suspension is fed into the vessel where the molten sulphur collects in drops which, as a result of their greater density, sink downwards, while the water rises in the vessel and leaves the vessel through a top outlet. The sulphur paste processed in the pressure vessel may, however, also contain very small sulphur particles depending upon the preceding process, and the rate of suspension thereof after melting is below the rate of ascent of the water in the vessel. These fine particles are not separated, and leave the pressure vessel together with the water through the top outlet.

By means of the present invention it is possible to separate even very fine sulphur droplets. It would be possible to increase the cross-section of the pressure vessel and thus reduce the rate of ascent of the water to such an extent as to keep it below the rate of suspension of even the fine sulphur particles, but this would entail such a large pressure vessel diameter as to make it economically unviable.

Broadly stated, the invention consists in a pressure vessel for continuously separating sulphur from an aqueous sulphur suspension, the vessel being divided by a partition, which at least in part defines apertures or slots, into an upper part containing heating means and a rotary device, and a lower part serving as a settling vessel and having a sulphur outlet at its bottom, the vessel including inclined separating plates which are located between the heating means and the wall of the vessel.

Preferably, two annular chambers are formed in the upper part by two cylindrical heating devices mounted vertically and coaxially one within the other, the inclined separating plates being located in an outer annular chamber between the outer heating device and the wall of the pressure vessel. Preferably, each heating device is in the form of a heating tube coil.

It has been found that the separating effect in the outer annular chamber, i.e. the space between the pressure vessel jacket and the out r heating tube coil, can be greatly increased, without increasing the diameter, if a ring of inclined separator plates is incorporated in this outer annular chamber. In this way the sedimentation effect is greatly impr ved, as a result of an increase in the sedimentation surface horizontal pr jection, which governs the sedimentation operation.

The invention may be perf rmed in various ways, and one sp cific mbodiment will now be described with reference to the accompanying drawing, which is a simplified sectional side elevation of a pressure vessel according to the invention. The pressure vessel of this example has a wall *a* surrounded by a steam-heated jacket *b*. A shallow conical partition *c* divides the vessel into a top part *d* and a bottom part *e*. An annular slot is left between partition *c* and the pressure vessel wall.

Two groups f_1 and f_2, of heating coils, are mounted in the top part of the vessel and form the heating system. They are in the form of coaxially spaced vertical cylinders, thus dividing the top part *d* of the vessel into an inner annular chamber disposed between the two groups f_1 and f_2, and an outer annular chamber *m* between the outer group f_1 and the wall *a* of the pressure vessel. A propeller *g* is mounted in the chamber enclosed by the inner group f_2 and drives the liquid in the vessel in a toroidal circulating movement as shown by the arrows. The outer group f_1 may, if required, be replaced by a single cylindrical wall.

Sulphur paste is introduced through a nozzle *h* in the top of the vessel, fitted with a gravity valve *i*. After being poured in, the paste gradually heats up and the suspended sulphur melts. The molten sulphur collects in drops which, owing to their greater density, sink downwards and flow through the annular space between the wall *a* and the partition *c* into the settling chamber *e*. The sulphur melt is withdrawn through the bottom outlet *l*.

In the top part of the vessel the molten sulphur paste initially moves in the direction of the arrows around the inner group f_2 of heating coils. The water rises in the annular chamber *m* and leaves the pressure vessel through a nozzle *p*. To ensure that very fine sulphur droplets are separated, inclined separator plates *r* are provided, and are mounted in the annular chamber *m* in the form of a ring.

The fluid is substantially stagnant in the settling chamber so that phase separation proceeds undisturbed under gravity and a boundary surface *k* forms between the sulphur phase (at the bottom) and the water (at the top). The height of surface *k* can be kept constant by continuously withdrawing molten sulphur through the bottom outlet *l*.

Measuring devices are provided for measuring the differential pressure Δp_0 between the gas and water phase and the differential pressure Δp_k between the water and sulphur phase. According to an ther preferred f ature of th invention, the differential pressure Δp_x between the water and the sulphur phase is measured and regulating devices ar provided to maintain a constant water level *o* and phase boundary surface *k* and to r gulat the outflow of separated liquids in dependence on the liquid levels.

The two differential pressures Δp_x and Δp_k can by calibration each be associat d with given heights of the phase boundary surface *k*. During normal operation, the measurements for Δp_x and Δp_k give the same values for the height of the phase boundary surface. If the values are different, the difference indicates that a layer having a different density (usually dirt and sludge) has formed in the neighbourhood of the surface *k*. The layer can be withdrawn through a sludge-removal nozzle *q*.

The pressure vessel illustrated operates at a pressure between 2 and 5 bars corresponding to a water temperature of 120° to 150°C. Saturated steam at a temperature between 125° and 155°C is preferably used for heating purposes.

The entire apparatus is heated, preferably by a steam-heated jacket, thus preventing the vessel walls from cooling unacceptably, since that would entail the solidification of sulphur thereon, thus forming projections.

CLAIMS

1. A pressure vessel for continuously separating sulphur from an aqueous sulphur suspension, the vessel being divided by a partition, which at least in part defines apertures or slots, into an upper part containing heating means and a rotary device, and a lower part serving as a settling vessel having a sulphur outlet at its bottom, the vessel including inclined separating plates which are located between the heating means and the wall of the vessel.

2. A pressure vessel according to claim 1, in which two annular chambers are formed in the upper part by two cylindrical heating devices mounted vertically and coaxially one within the other, the inclined separating plates being located in an outer annular chamber between the outer heating device and the wall of the pressure vessel.

3. A pressure vessel according to claim 2, in which each heating device is in the form of heating tube coils.

4. A pressure vessel according to claim 2 or claim 3, in which the rotary device includes an upwardly conveying propeller located inside the inner heating device.

5. A pressure vessel according to any one of claims 2 to 4, in which the separating plates are arranged in the form of a ring in the outer annular chamber.

6. A pressure vessel substantially as hereinbefore described with reference to the accompanying drawing.

7. A method of continuously separating sulphur substantially as hereinbefore described with reference to the accompanying drawing.

8. Sulphur when separat d from an aqueous sulphur suspension by the method or apparatus of any of the pr ceding Claims.

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